Claims

1. A motor vehicle air conditioning unit, provided with a supercritical refrigerant circuit (10) comprising a compressor (14), a gas cooler (11), an expander (12), defining a refrigerant flow area, and an evaporator (13), the assembly further including an electronic control device designed to interact with the refrigerant circuit,
characterized in that the electronic control device includes a calculating function using an estimate of the flow area of the expander, the density (ρ) of the refrigerant and the pressure (P_{20}) of the refrigerant at the inlet of the expander in order to calculate an estimate of the refrigerant mass flow rate (m_{exp}) at the expander.

2. The air conditioning unit as claimed in claim 1, characterized in that the flow area of the expander is estimated from the value of the refrigerant pressure (P_{20}) at the inlet of the expander.

3. The air conditioning unit as claimed in claim 2, characterized in that the electronic control device is capable of reacting to the fact that the value of the refrigerant pressure P_{20} at the inlet of the expander is:

. less than or equal to a first pressure value P1, a first constant S1 being assigned to the flow area S of the expander;

. less than or equal to a second pressure value P2 greater than the first pressure value P1, by solving the following equation in order to calculate an estimate of the flow area S of the expander:

$$S = S1 + (S2-S1) \times (P_{20}-P1)/(P2-P1),$$

where S2 is a second constant;

. less than or equal to a third pressure value P3

. less than or equal to a third pressure value P3 and greater than the second pressure value P2, solving the following equation in order to calculate an estimate of the flow area S of the expander:

$$S = S2 + (S3-S2) \times (P_{20}-P2)/(P3-P2),$$

where S3 is a third constant; and

. greater than or equal to the third pressure value P3, a fourth constant S4 being assigned to the flow area of the expander.

4. The air conditioning unit as claimed in claim 3, characterized in that the first pressure value P1 is approximately equal to 80 bar, the second pressure value P2 is approximately equal to 110 bar and the third pressure value P3 is approximately equal to 135 bar and in that the first constant S1 is approximately equal to 0.07 mm^2, the second constant S2 is approximately equal to 0.5 mm^2, the third constant S3 is approximately equal to 0.78 mm^2 and the fourth constant S4 is approximately equal to 3.14 mm^2.

5. The air conditioning unit as claimed in one of the preceding claims, characterized in that the calculating function is specific to calculating the density (ρ) of the refrigerant from the refrigerant temperature (T_{30}) at the inlet of the expander and from the refrigerant pressure (P_{20}) at the inlet of the expander.

6. The air conditioning unit as claimed in claim 5, characterized in that it includes a probe (30) placed at the inlet of the expander (12) for measuring the refrigerant temperature (T_{30}) at the inlet of the expander.

7. The air conditioning unit as claimed in one of the preceding claims, characterized in that it includes a sensor (20) placed at the inlet of the expander (12)

for measuring the refrigerant pressure (P_{20}) at the inlet of the expander.

8. The air conditioning unit as claimed in one of the preceding claims, characterized in that the electronic control device further includes a power estimation function capable of estimating the power absorbed by the compressor from:

- the refrigerant mass flow rate (m_{exp}) provided by the calculating function;
- the work (ΔHise) of the compressor; and
- the rotation speed (N) of the compressor.

9. The air conditioning unit as claimed in claim 8, characterized in that the electronic control device is capable of estimating the work (ΔHise) of the compressor from the refrigerant pressure (P_{20}) at the inlet of the expander, from the refrigerant pressure (P_{35}) at the inlet of the compressor and from a refrigerant temperature (T_{comp}) relative to the compressor.

10. The air conditioning unit as claimed in claim 9, characterized in that the refrigerant pressure (P_{35}) at the inlet of the compressor is estimated from a pressure (P_{50}) at the inlet or at the outlet of the evaporator (13) combined with the refrigerant mass flow rate (m_{exp}).

11. The air conditioning unit as claimed in claim 10, characterized in that the pressure (P_{50}) at the inlet or at the outlet of the evaporator (13) is determined from the refrigerant temperature (T_{50}) at the inlet or at the outlet of the evaporator (13), said temperature being either measured by a probe or estimated from:

- a temperature (T_{40}) relative to the evaporator (13);

- the efficiency (η_{evap}) of the evaporator (13); and
- the temperature (T_{60}) of the air to be cooled.

12. The air conditioning unit as claimed in one of claims 9 to 11, characterized in that the refrigerant temperature relative to the compressor (10) is the refrigerant temperature (T_{35}) at the inlet of the compressor.

13. The air conditioning unit as claimed in claim 12, characterized in that it includes a probe (35) placed at the inlet of the compressor (14) for measuring the refrigerant temperature (T_{35}) at the inlet of the compressor.

14. The air conditioning unit as claimed in one of claims 9 to 11, characterized in that the refrigerant temperature relative to the compressor (14) is the refrigerant temperature (T_{36}) at the outlet of the compressor.

15. The air conditioning unit as claimed in claim 14, characterized in that it includes a probe (36) placed at the outlet of the compressor (14) for measuring the refrigerant temperature (T_{36}) at the outlet of the compressor.